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SOME PRINCIPLES OF MUSEUM ADMINISTRATION

IN No. 641 of SCIENCE (April 12, 1907) Dr. George A. Dorsey discusses in some detail the installation of the ethnological collections in the American Museum of Natural History, basing his criticism essentially on the point of view that the arrangement is an unsatisfactory attempt at popularizing the results of ethnological research. In his discussion he assumes that the essential object of a large museum must be research, not instruction, without, however, discussing the validity of this fundamental assumption.

I may be allowed in the following remarks to discuss what seems to me the vital question of the uses of museums as research institutions and as educational institutions. Since my own practical experience has largely been gained in ethnographical museums, I may be allowed to take my examples particularly from these, indicating at the same time in what respects ethnological museums seem to differ from natural-history museums.

Museums may serve three objects. They may be institutions designed to furnish healthy entertainment, they may be intended for instruction and they may be intended for the promotion of research.

The value of the museum as a resort for popular entertainment must not be underrated, particularly in a large city, where every opportunity that is given to the people to employ their leisure time in healthy and stimulating surroundings

should be developed, where every attraction that counteracts the influence of the saloon and of the race-track is of great social importance. If a museum is to serve this end, it must, first of all, be entertaining, and try to instill by the kind of entertainment offered some useful stimulant. The people who seek rest and recreation resent an attempt at systematic instruction while they are looking for some emotional excitement. They want to admire, to be impressed by something great and wonderful; and if the underlying idea of the exhibit can be brought out with sufficient clearness, some great truths may be impressed upon them without requiring at the moment any particular effort. The visitor of this class does not go to the museum to study the exhibits case by case and to follow a plan carefully laid out by the curator, but he strolls through the halls examining something that attracts his attention here and there without much plan or purpose.

It is a fond delusion of many museum officers that the attitude of the majority of the public is a more serious one; but a calm examination of the visitors passing through museum halls shows very clearly that the majority do not want anything beyond entertainment. This can easily be proved by following them through the halls and listening to their remarks, by the general tendency of visitors to go through all the halls of the museums from end to end in order 'to have seen' the museum. It may be seen in the Sunday afternoon crowds in New York City when parents pass the hours after dinner with their children in pleasant surroundings, trying to take in the curious sights.

If this is true, then the very serious question arises, what can be done for this very large class of visitors? Obviously, a systematic exhibit will not appeal to them, and the best we can hope for is to bring home to them by single exhibits important points of view. Most of our museums are not built on a plan which promises success in this direction. To impress a point of view requires at least the possibility of concentration; while our large halls, built with a view to architectural impressiveness, do everything that is possible to distract the visitor, who, when just beginning to take in one exhibit, already looks forward to the next one, thus being prevented from ever concentrating his attention on any particular subject. Effectiveness must be based on the effort to concentrate attention, and on the unity of the idea expressed in each exhibit. Those who have seen the room in the Dresden Museum containing the Sistine Madonna will know what I mean. In this room is nothing to distract the attention of the visitor from the single exhibit, and consequently the room is a sanctuary.

It seems essential that before deciding upon the selection of subjects to be presented to the public, the museum director should be clear as to the objects to be obtained by popular exhibits. Popularization of science has become of late years a kind of Shibboleth, and we are only too apt to believe that an effort to present in a simple way results of scientific inquiry is in itself a praiseworthy endeavor.

I fear that in this belief some of the fundamental objects of the popularization of science are overlooked. In the mass of lectures intended to popularize knowledge, in popular books, and not less in popular museums, intelligibility is too often obtained by slurring over unknown and obscure points which tend to make the public believe that without any effort, by listening for a brief hour or less to the exposition of a problem, they have mastered it. This I consider one of the serious dangers of popular presentation of science. It is a stimulus to the overestimation of one's

own powers, which is so characteristic of many phases of our public life. It tends to stimulate the idea that the necessity for training for thorough work is an antiquated prejudice, and that good common sense with a little smattering of knowledge fits a man for any place in life, in business as well as in science and in public affairs.

What I understand by popularization of science is an endeavor to counteract these very influences, and to bring out the sublimity of truth and the earnest efforts that are needed to acquire it. Therefore every kind of inaccuracy should be most carefully avoided, and attempts to make all problems appear childishly simple by the elimination of everything that is obscure should not be tolerated.

This does not mean that the most complex problems should be selected for popular presentation, but the serious effort required to reach results should be emphasized. To apply this to the striking popular exhibits to which I referred before, enough should be given surrounding these exhibits to convey the impression that the visitor, by looking at the single thing, has not grasped all that is conveyed by the collections, and that there is more to study.

Another point of view should be borne in mind. When the technical perfection of the striking exhibits is very great, the danger is ever-present that the admiring public will not see the idea that is to be conveyed by the exhibit, but will forget even to look for it in its admiration of the technical skill exhibited in the installation. For instance, in an exhibit of gulls hovering over the waves of the sea, it is only too likely that the visitors will ask, 'How are they suspended?' and that upon coming back from the museum, they will tell their friends of the skill exhibited in the invisible suspension of the birds, but presumably they will not know what birds they were. Thus every incidental point that is added to the essentials of the exhibit will distract attention from the fundamental idea. I fear that in some cases an interest in the artificial likeness to nature may be engendered like that felt by the courtiers of the Emperor of China in Andersen's fairy tale, 'The Nightingale,' when they all exclaim on discovering that the nightingale is not a mechanical toy: 'How uninteresting! It is a real bird!'

In order to attract the attention of the visitors who stroll through the halls, the museum needs a somewhat indifferent background of material, from which is set off here and there a striking exhibit intended to arrest attention; and the art of the museum administrator consists in the proper selection of such exhibits as will drive home a definite idea. A museum consisting only of an array of striking exhibits defeats to a certain extent its own ends, because where a great many objects of equal interest are assembled, the attention given to each is only slight. Furthermore, the indifferent background which consists of exhibits related to the one illustrating a particular idea elucidates the vastness of the problem dealt with, and is a check against the superficial assumption that the one exhibit exhausts the subject.

There are only two methods possible to reach the visitors who come to the museum to be entertained. The one is to have only a very few exhibits of rare beauty and excellence, which by their own merit will prove attractive. An attempt to carry this idea into execution has been made in parts of the Museum of the Brooklyn Institute. However, this is avowedly neither the object nor the method of a large museum which endeavors to gather under its roof a great variety of objects, and to impose not only by a small selection of ex-

hibits, but also by the comprehensiveness of subjects presented. Wherever this is true, it must be recognized that it is impossible to hold the attention of the people by the whole mass of exhibits, but that for every visitor the bulk of the material must merely give the background from which some subject that happens to strike his fancy will stand out in bold relief.

I think the experience of all large museums shows that this point of view, so far as the general public is concerned, is the correct one. When, for instance, the installation of a new immense mounted skeleton of some extinct animal is announced, people will flock in crowds to the museum to see the specimen, and the receptiveness of their minds is increased by the whole mass of material from which the new impressive specimen is set off, and by the striking difference of the atmosphere in the museum as compared with the ordinary everyday routine. The same is true when a large, beautiful group of birds is exhibited. The impression, however, is quite different if the museum should contain a great many mounted skeletons of immense size, or a great many groups of birds of similar character. The visitors will pass from one to another, but the amount of impressiveness of each will be correspondingly decreased.

Considering this point of view, I think no word has ever been said that is less true than Dr. Brown Goode's oft-repeated statement that a museum is a well-arranged collection of labels illustrated by specimens. On the contrary, the attraction for the public is the striking specimen; and whatever additional information either the label or the surrounding specimens may be able to convey to the mind of the visitor is the only result that can be hoped for.

I believe experienced museum administrators will agree with me in thinking that among the museums having the best attendance, so far as it is not artificially increased by including the attendance of lectures among the museum visitors, this class of visitors amounts easily to ninety per cent. or more of the total number. This is true particularly of the United States National Museum, which is simply taken in as one of the sights of the national capital, and it is also true of the Saturday and Sunday attendance of a museum like the American Museum of Natural History in this city.

I am inclined to think that the museum can do a great deal towards public education by a judicious treatment of this aspect of its work; but it requires the highest talent to select and set off a striking object which brings home an important idea against the indifferent background so as to obtain the best results.

From the remarks that have been made, it will be seen that in a large museum opportunity is given to select objects in such a way that a great variety of important points of view are brought out by special exhibits.

An attempt of this kind has been made, in the large entrance-hall, a number of very excellent exhibits are arranged, partly of a systematic character, partly intended to bring out certain special biological points. I believe the feeling that is conveyed here upon the visitor is a very favorable one, in so far as the assemblage of this material in the entrance has for its background the expectancy created by the mass of material to be found when the visitor moves from this hall into the galleries of the building. On the other hand, it may be said that still better results might be had if these halls themselves were to contain here and there equally striking exhibits.

I believe the appreciation of the needs of the visitor who wants to be entertained has led most museums to lay much stress upon the preparation of groups in which certain objects are brought together, and which are generally intended to illustrate

some important point. In the practise of group-making that has developed during the last fifteen years the need of the class of visitors for whom they are intended is often lost sight of. A group does not convey any more information than a picture in an ordinary picture-book might be made to convey. It differs from the picture-book in being more impressive by its size and surroundings. Therefore a series of groups, all of which illustrate different aspects of the same idea, are undesirable, because the impressiveness of each is decreased by the excessive application of the same device. I believe the effect of this undue multiplication of groups of the same type may be noticed in the collections of the United States National Museum. It is true that the multiplication of groups in the anthropological department of that museum is not due to a systematic endeavor on the part of the administration to present every Indian type in the form of a group. It is due rather to the onerous duty imposed upon the museum to send some new striking exhibit to every one of the endless series of national and international expositions, which, of course, are seen almost exclusively by sight-seers, who can not be reached by anything but such large exhibits as groups. Any one who will observe the visitors of the United States National Museum strolling through the Catlin Hall, which contains the Indian groups, will readily see how the first group seems very interesting, and how quickly the others appear of less and less interest and importance. For this reason it may safely be said that the method of bringing together large exhibits should be employed only sparingly, and that the effect of each of these exhibits will be the greater the better it is set off against an indifferent background.

I have mentioned here large exhibits as those which will attract the general public. This is not quite correct, in so far as there will always be an appreciable number of visitors of a higher education, who may be attracted by the beauty and compact idea brought out by small special exhibits.

Museums may also be employed for the purpose of imparting systematic information. The number of people who visit the museum in search of such information is, comparatively speaking, small, but not by any means negligible; and the duty of the museum to supply such information to those who are in search of it must not be questioned. The question arises, however, in how far a very large museum is capable of supplying the needs of students of this type. Assuming a building like the American Museum of Natural History, which has at present eighteen halls and six galleries, with a floor space of from eight to ten thousand feet for the halls, and of from four to five thousand feet for the galleries, and imagining the various halls so arranged as to give a systematic presentation of the various sciences, we find that the whole becomes such a maze of separate and intercrossing systems, that the average visitor, even if desirous of obtaining systematic information, would be frustrated by the mass of material presented.

Here, obviously, the fundamental principle of elementary education has to be applied; namely, that effectiveness does not lie in diversity, but in the thoroughness of the material presented. *Multum, non multa.* So far as I am aware, the attempt at systematizing the collections of a very large museum according to a rigid scheme has never been made, obviously on account of the insuperable difficulties that present themselves.

One of these difficulties consists in the lack of systematic collections illustrating all the different branches of science. This lack is very striking in all our American

museums, where the mass of material consists almost everywhere of collections from North America, and where material from other continents is very inadequately represented. There is no inherent difficulty in obtaining small systematic collections covering any particular branch of science, but in a large museum there is always a preponderance of material relating to particular problems or to particular regions. This lack of material will always be an obstacle to a complete systematization of large collections, even if such systematization were desirable. A number of small museums have tried to develop representative and systematic collections, with excellent success, and have become in this way important adjuncts for the teaching facilities of the cities in which they are located; but here efficiency is inseparable from small size.

The difficulties that lie in the way of arranging a large museum according to a systematic plan of instruction are manifold. First of all, it must be recognized that in a large city people with entirely different interests will consult the museum, and will therefore desire to find the material in entirely different systematic arrangement. To take the example of zoology. One teacher may desire to utilize the museum for his classes in which he gives a review of systematic zoology. Another one may desire to impress upon the student the development of the nervous system or of certain organs of the body. Still another may be interested in the essential phenomena relating to the question of evolution of species. And still another may want to illustrate by means of collections the traits of local faunas. The greater the number of people who desire to consult the museum in this manner, the more numerous will also be the points of view from which systematization will appear desirable. I think even to those not familiar with museum administration it will be at once apparent that the attempt to organize the entire collections of a large museum from this point of view can have only one result. If every justifiable point of view is included, the complexity of the system will become so great that the usefulness of the whole series will become very doubtful. If, on the other hand, only a few points of view are selected, then all sciences as presented in that particular museum will appear in the strait-jacket into which they have been put by the narrowness of the selected view-points, while the material should rather be so arranged that it can be grasped from a multitude of points of view.

The experience of school museums and of university museums points clearly the way in which this difficulty may best be solved. A large museum might have a wing or a small group of halls set aside for the purpose of systematic instruction, where classes could be taken from one case to another, and where the essential points of view which are used in the ordinary teaching of science are utilized as the principle of installation; but the usefulness of these halls should not be overestimated, because the museum, with its mass of exhibits, is not a favorable place to obtain concentration of attention of students. That much can be attained in this manner by a small museum, and with very slender means, is shown, for instance, by the museum in Salem, Mass., which, with an annual appropriation of $8,000 (including all salaries, maintenance and purchases), has, under the able direction of Professor Edward S. Morse, done much for public education.

In cities of the size of New York or Chicago or Philadelphia, the best use of such a centralized collection can not be made. On account of the enormous distances in the city, it will very seldom be possible to assemble at any definite time in the museum

a group of students who might profit by a collection of this kind. Furthermore, the collection, once installed in a large museum, and intended to serve teaching interests scattered all over the city, must necessarily be more or less stationary—and the more so, the more money is expended on excellence of installation—and can not be adapted to the needs of different schools. For this reason the system which is used in many schools, of having separate school museums which are intended to serve this purpose, is infinitely preferable, and renders entirely unnecessary the attempt to make a large institution serve primarily the demands of school classes.

To take again the example of the American Museum of Natural History, I believe it is claimed by the administration of that museum that the systematic arrangement of collections assists the public schools, and that the large appropriation which the museum receives from the city is largely justifiable for this reason. The appropriation amounts, I believe, to nearly two hundred thousand dollars annually, while the buildings without grounds represent an approximate value of three million dollars. If we imagine that only one third of this annual appropriation were used for the maintenance of school museums, and that instead of the single large complex of buildings, twenty small museum buildings were established in various parts of the city, these ends would be infinitely better subserved, and the central museum—that is, the American Museum of Natural History—would be relieved of a duty which it tries to perform, but which, owing to the very size of the institution and of the city, it can not fulfil. Such small museums would have the same relation to the main museum, that the branches of the public library have to the central library, which, through this agency, has increased its educational usefulness many times, and has diverted a certain class of demands from the central library into other channels better able to meet them.

It would be an excellent plan if that museum and others similarly supported were required to furnish school museums with the necessary material and information, leaving to the teachers of the schools the free use of the specimens, for no printed label can take the place of the freedom of selection of specimens, picked out by the teacher as occasion may arise in the course of his instruction.

For a great many years attempts have been made in France and Switzerland, and these have recently been repeated in America, to arrange small collections for public-school use, and to send these about from school to school. This attempt deserves every encouragement, although here also in our large New York schools there will be ample opportunity for the use of specimens to justify the establishment of small permanent school collections, which will be found much more economical than the constant transportation of museum material from place to place, and which may be purchased at fairly reasonable rates from dealers in teaching-material.

Even if such school museums were established, it would still be justifiable, and perhaps desirable, for the museum to maintain a few halls intended for systematic instruction; but if museums are to serve only educational purposes, then large museums are not only unnecessary, but even undesirable.

The same objections that may be raised against the wholesale elimination of large collections from the exhibits, and the retention of striking exhibits only, should also be raised against the schematization of museum material. Nothing perhaps helps more to convey the idea of completeness and of the uselessness of further effort than the presentation of a whole museum as a

complete finished exhibit, in which everything has its place in a definite system. Such a museum will fail to bring home the complexity of nature and an appreciation of the efforts required for a mastery of its secrets.

The impossibility of basing museum installation on a classification of objects from a single material point of view can be made clear best by the example of anthropological exhibits. At the same time this consideration will show in what the difference between anthropological collections and natural-history collections consists. An assemblage of material such as is found in anthropological collections consists entirely of things made by the various peoples of the world—their tools, household utensils, their ceremonial objects, etc. All of these are used in the daily life of the people, and almost all of them receive their significance only through the thoughts that cluster around them. For example, a pipe of the North American Indians is not only a curious implement out of which the Indian smokes, but it has a great number of uses and meanings, which can be understood only when viewed from the standpoint of the social and religious life of the people. It even happens frequently in anthropological collections that a vast field of thought may be expressed by a single object or by no object whatever, because that particular aspect of life may consist of ideas only; for instance, if one tribe uses a great many objects in its religious worship, while among another, practically no material objects of worship are used, the religious life of these tribes, which may be equally vigorous, appears quite out of its true proportions in the museum collections. Another reason, namely the natural destruction of material, makes it quite impossible to make archeological collections systematic. Thus it happens that any array of objects is always only an exceedingly fragmentary presentation of the true life of a people. For this reason any attempt to present ethnological data by a systematic classification of specimens will not only be artificial, but will be entirely misleading. The psychological as well as the historical relations of cultures, which are the only objects of anthropological inquiry, can not be expressed by any arrangement based on so small a portion of the manifestation of ethnic life as is presented by specimens. Any one who has grasped this truth will recognize at once that an anthropological exhibit can not be cast into the single schematic mold which is to be repeated automatically the world over for every single people. With the wealth of interesting and important problems of anthropology, it is, however, perfectly easy to bring out in a popular manner one salient point here, another salient point there, according to the characteristics of the life of the people dealt with.

The difference between anthropological exhibits and those relating to natural sciences is only one of degree, because in no case do specimens alone convey the full idea that a collection is intended to express. This is particularly true in any exhibit intended to express function rather than form; as, for instance, in exhibits illustrating dynamic geology or facts relating to the physiology of plants and animals. The difference between anthropological and natural-history collections, however, consists in the trifling importance of the specimens as compared with their functional importance in anthropology, and to the fact that all the specimens are primarily incidental expressions of complex mental processes that are themselves the subject of anthropological inquiry. These latter are almost entirely missing in that field of biology which is ordinarily presented in museums.

For this reason anthropological collections should be treated like collections of artistic industry and art collections rather than like collections illustrating natural sciences.

It is therefore clear, that, so far as the public is concerned, the essential point of view of the anthropological collection and that of the natural-history collection are entirely distinct; and, if the attempt is to be made to bring out coherently the ideas underlying the anthropological exhibit, there ought to be no necessity for the visitor to come into contact with the natural-history exhibits while passing through the anthropological halls. On the whole, this end is difficult to attain in a large complex museum building; and the question may therefore be very well raised, whether it would not be better to separate entirely anthropological collections from those relating to natural history.

Still another consideration may be mentioned here, which has an important bearing upon the systematic arrangement of anthropological collections. It has been pointed out before that anthropology is essentially an historical science, and consequently not readily amenable to systematization; but, further than this, there is so much disagreement among the best anthropologists of our times in regard to the significance of anthropological data in a systematic presentation of the subject, that it seems hardly justifiable for any museum to assume to dictate by its arrangement what the approved system of anthropological science shall be.

Before further discussing the question of museum policy in regard to its relation to the public and to schools, it may be well to discuss the value of the museum as an institution intended to serve the progress of science.

The objection which is raised against the concentration of the work of the large museum in these lines rather than in educational lines is the old objection against serving the few rather than the masses. Serious educators have long since recognized that the education of the masses which we all desire is impossible without the most thorough and painstaking education of the teacher, and that the applicability of a sound educational system can not be confined to elementary schools, but that without secondary schools, colleges, universities and training schools for teachers, the whole system of public education falls to the ground. Therefore, we do not at all agree with the popular illusion that opportunities given to the few who advance science are opposed to the advancement of the masses, but we rather recognize in them an indispensable means of advancing public education.

I do not hesitate to say that the essential justification for the maintenance of large museums lies wholly in their importance as necessary means for the advancement of science. This is particularly clear in the case of the United States National Museum, which is the depository of all the government surveys, and whose duty it is to preserve the material on which the work of the surveys is based. The education of the masses can be infinitely better subserved by small museums.

What, then, is the function of the large museum? It is the only means of bringing together and of preserving intact large series of material which for all time to come must form the basis of scientific inductions. Every year shows more clearly that the loss of old collections, due to the lack of large museums until the middle of the last century, is one of the serious obstacles to the advancement of science. Museums are the storehouses in which not only must the material be preserved by means of which deductions of scientists can

be checked, but they are also the place where scientific materials from distant countries, vanishing species, paleontological remains, and the objects used by vanishing tribes, are kept and preserved for all future time, and may thus be made the basis of studies which, without them, would be impossible. We are spending vast sums year after year to bring together evidences of life forms of distant countries and of past ages, to accumulate the monuments of the past and objects used by remote tribes. We collect these because they are the foundation of scientific study. Should we then be unwilling to provide adequate means for keeping intact the results of our expensive inquiries? It is the essential function of the museum as a scientific institution to preserve for all future time, in the best possible way, the valuable material that has been collected, and not to allow it to be scattered and to deteriorate.

Considering this point of view, there can be no greater misconception of the duties of a museum administrator than the belief that proper care of accumulated material is less important than beautiful exhibits. The lack of proper care of inflammable and perishable material, the constant shifting about of material not used for exhibits, the lack of conservatism in exchanging and giving away collections for elementary educational purposes, belong to the most inexcusable features of museum administration. Unfortunately the method of preservation of collections in our museums is in many cases not what it ought to be, partly from necessity, partly from choice. The crowded condition of the building, like that of the United States National Museum, or the attempt to relegate vast amounts of material to storage-rooms, as in the American Museum of Natural History, and the use of wooden receptacles for the storage of valuable material, endanger the safety of the collections and make their use temporarily or permanently difficult. Serious scientists know perfectly well that in the study of biological and anthropological phenomena observations on a single specimen are generally misleading, and that one of the great advantages gained in modern times, and based to a great extent upon the improvement of museum methods, consists in the possibility of examining long series rather than individuals. The reason for this is that the series alone can give us what is characteristic, while, when only an individual is available, characteristic traits may be overlooked, or we may be liable to consider an accidental trait as characteristic for a whole group. For this reason science is better served by the preservation of large series relating to the same question in one place rather than by scattering such series over a great many different places. This is true of all sciences, and this is the justification for the accumulation of extended material bearing upon the same point. Inroads that are made upon large collections in order to obtain scattering material otherwise not represented in the museum should be resisted by every conscientious scientist.

In order to make large series useful, the bulk of the material in a museum should be kept in such a manner that it is not only accessible at a moment's notice, but that it can also be examined from any point of view. While in zoological collections consisting of skeletons and skins, this end may be attained fairly adequately by storage in metal boxes systematically arranged and easily opened, other material can not be handled in the same manner. This is particularly true of anthropological material, which, on account of the difference in size, form and material of the objects, and on account of the multiplicity of the points of view from which the material can be viewed, can only be stored

satisfactorily in such a way that each specimen can be seen.

I do not consider it necessary to discuss in greater detail the functions of the large museum as an agency in promoting science, because there can be little difference of opinion in regard to this question. Wherever investigations are undertaken that are based largely upon specimens needing preservation, the work is necessarily undertaken by a museum or by institutions closely affiliated with museums. It may be pointed out, however, that the strong tendency to accumulate specimens has often been a disadvantage in the development of anthropology, because, as was pointed out before, there are many aspects of this science in which the material objects are insignificant as compared with the actual scientific questions involved.

The experience of institutions like the Field Museum of Natural History and the United States National Museum shows clearly that the necessity of accumulating collections practically excludes important aspects of anthropological work from the field of museum activity. In former times the American Museum of Natural History followed a more liberal policy in this respect, while at present the broader point of view seems to be gradually becoming recognized in the Field Museum; but the rapid changes of policy through which these institutions have passed show that anthropology requires a broader point of view for its field-work than that offered by the strict requirements of the acquisition of museum specimens. The only institution in which the necessary freedom is offered is the Bureau of American Ethnology, which is not hampered by any requirement of accumulating specimens through its investigations.

This same point of view brings it about that museums of natural history are liable to lay much greater stress upon systematic zoology and botany than upon detailed anatomical study, the results of which can not be exhibited equally well, and that the study of functional traits is hardly ever attempted, because it offers still greater difficulties to the exhibitor.

So far as the scientific administration of museums is concerned, the principal problem is that of the extension of museum activities so as to overcome the limitations set by the tendency to acquire a considerable number of specimens.

I believe that among American museum administrators Professor F. W. Putnam deserves the highest credit for having been the first to recognize the limitations of the activity of the museum if restricted entirely by the desire for the acquisition of specimens, and for having courageously set to the museum scientific problems selected in accordance rather with their scientific importance than with the probability of yielding many specimens.

Bearing these points in view, the question arises, in how far the interests of the public and the interests of science can be harmonized. It is my opinion that the attempt at a thorough systematization of a large museum must be given up, because it is based upon a misconception of the function of the large museum. Systematic museums must be small museums.

It is very probable that in a large museum in which the systematization of the exhibit for the benefit of educational purposes is made the principal point of view the function of the individual curator will become more and more that of an officer who carries out the orders received from the general museum administration, so that there would hardly be room for investigators of the highest order in such an institution. That the systematization and popularization of the collections of a large museum does not agree with the best interests

of science, has evidently been felt by the administration of the United States National Museum, in which, in the Biological Department, the work on the exhibit halls has been divorced completely from the scientific work on the collections.

The question then arises, What shall we do with our collections to make them useful to the public and at the same time useful for the advancement of science? Two methods are possible for reaching this end. Either we may have a complete separation of the collections intended for the public and of those intended for the scientist, or we may decide to make the entire collection equally accessible to the public and to the scientist.

Reasons may be brought forward in favor of either method, and it is largely a question of economy what method shall be pursued. The method adopted will also determine the form of the museum building. Unfortunately this point of view is seldom considered in planning museum edifices. Taking the example of the American Museum of Natural History, we find the whole museum, with the exception of the cellar and the top floor, which is a half-attic, laid out in large magnificent halls, which, of course, means that the whole museum is to be accessible to the public. Consequently there is no choice but to subserve in the exhibits both the aims of the scientist and those of the general public. The proportional amount of space available for storage in a building of this kind is so small that full use of the stored material for scientific purposes is entirely out of the question. The opposite point of view has been followed in the Zoological Museum in Berlin, one of the very few buildings in which the deliberate attempt has been made to separate exhibit collections from study collections. Here, however, the space allotted to the study collections is more than twice as large as the space allotted to exhibit collections.

If a museum is planned like the American Museum of Natural History, the only thing to do is to acknowledge freely that the public is to be admitted to all the collections in the museum; to arrange the collections from scientific points of view, and to set off from these collections in conspicuous places those exhibits which are intended for the public. The central aisles of the large halls, for instance, lend themselves admirably for exhibits of this type, while the side alcoves may be used to furnish the indifferent background from which the popular exhibits should be set off.

I am not by any means convinced that this is the best solution of a difficult problem. The attempt to make accessible in this way the entire collections is unnecessarily expensive; and the work that must go on in the collections, if the museum is to be a live institution at all, will tend to distract from the dignity of the halls, which I consider, so far as the public is concerned, as one of the essential features of the museum. It seems to me that while the public is admitted to a museum hall, everything in the hall should be calculated to increase the impression of dignity and of aloofness from every-day life. No dusting, no mopping, no trundling-about of boxes, should be permitted in a hall visited by the public, because it disturbs that state of mind that seems best adapted to bring home the ideas for which the museum stands.

It has been proposed to overcome the economic difficulty involved in the necessity of having large collections accessible, and the expensiveness of exhibit halls intended for the public, by placing the study collections outside of the large cities, in suburbs, where land is inexpensive, and where unpretentious buildings can be erected. This

proposition has been made in England, and has been carried out by the Ethnographical Museum in Berlin. Although the separation of the exhibit collections and the storage collections involves considerable administrative difficulties, and is open to scientific objections, it is not impossible that we shall necessarily be led to the adoption of this principle of administration. While, however, the collections are concentrated in one large building, we must accept the principle that the collections must receive proper care, and must be available for scientific study. In our museum buildings with which we have to get along at the present time, this end might very well be attained by placing either in one wing or on one floor the exhibits intended for the general public, and also those intended for students in high schools, special training schools, colleges, and even for many students of universities. In collections of this kind the more advanced collections intended for students would give what I called before the indifferent background which is so necessary for the general public. A large number of halls, however, will have to be installed in a more condensed manner, perhaps by adding galleries to halls of unnecessary height, in which material could be made accessible to students. There is no reason why the public should not be admitted to halls of this kind, although presumably very few of the visitors would carry away any other impression than that of the magnitude of the field of work covered by the museum. A thorough reorganization of museum administration will not be possible until the plan of operation of the museum is decided upon before the museum building is erected, and until the small systematic educational museum, which serves as an adjunct to elementary instruction, is separated entirely from the large museum. Like the university, the large museum must stand first and last, in its relation to the public as well as in its relation to the scientist, for the highest ideals of science.

FRANZ BOAS

SCIENTIFIC BOOKS

THE COLLECTED WORKS OF GEORGE WILLIAM HILL

THE Carnegie Institution of Washington has already undertaken many forms of scientific activity during the short period of its existence. These may be divided into two classes. First, the cases where it assists science indirectly by a grant to an individual for the prosecution of some piece of work which might or might not be done without this aid; and second, the cases where some particular branch of knowledge is to be advanced or assisted by expenditure on lines which will not benefit any individual in particular, either in money or in reputation. There is considerable doubt whether an ultimate gain is to accrue to the scientific world from the former method: the danger of pauperizing research is a matter which can not be regarded lightly, for the most notable contributions have more frequently been made by those who have done their work in spite of difficulties and who, under an easier régime, would not have felt the need for exertion. Little criticism can be made on the second class of cases, where organization and a large equipment is frequently required. The routine work involved in making or collecting or publishing huge masses of data is often neither possible for an individual nor stimulating to any one who is obliged to undertake it for some definite object which he may have in view.

To the second class belongs some of the work that may be done by a publishing house whose sole concern is not the maximum financial gain to be extracted from its operations. Of this there already exist excellent English examples in the Pitt Press at Cambridge and the Clarendon Press at Oxford. It is true that these businesses are run on a commercial basis in so far as they publish books which appeal to a large circle, but they also issue works on which a considerable financial loss is expected, so that the net annual profit is not

large. The trustees of the Carnegie Institution early recognized the fact that similar opportunities were needed in the United States for publications which the scientific societies are too poor to undertake, and which, for a business firm, would simply mean a gift to education. The subject of this article is one of the earliest projects of the institution; its successful completion gives reason to hope that it may be the forerunner of others on the same lines.

The memoirs of Dr. G. W. Hill occupy over seventeen hundred pages arranged in four quarto volumes. Of these just one third (Vol. III.) are taken up by his well-known theory of Jupiter and Saturn. In his preface to this work Dr. Hill says: "It was desired to abandon the use of the antiquated tables of Bouvard, and it appeared uncertain when Leverrier would publish his. The plan, therefore, was to form theories of Jupiter and Saturn which would be practically serviceable for a space of three hundred years on each side of a central epoch taken near the center of gravity of all the times of observation; theories whose errors in this interval would simply result, not from neglected terms in the developments, but from the unavoidable imperfections in the values of the arbitrary constants and masses adopted from the indications of observation." How well he succeeded is now beginning to be seen. The observations which were used in forming the tables ended with the year 1888. In memoir 76, a comparison between the results of theory and observation is given from 1889 to 1900 which shows that the mean error for each year in right ascension and declination scarcely exceeds one second of arc. And further, unlike the comparisons from the majority of astronomical tables, the errors show no tendency to increase steadily as time goes on.

But the subject which is more closely associated with Dr. Hill's name is the theory of the moon's motion. It is difficult to overestimate the services which he rendered by the publication in 1878 of the one memoir, 'Researches in the Lunar Theory.' Before this time there had been a growing feeling amongst mathematicians that the motions of the moon and planets, as subjects for investigation on theoretical lines, had been worked out and that there was little to attract a student unless he wished to take up the practical side by more accurate computations of existing developments. This false view of the situation was corrected in a single step, although it was reserved for Poincaré to show the full importance of the advance which had been made by his development of Hill's idea of the periodic solution. But the advance from the point of view of computation was not far behind, since this paper also laid a basis for the accurate calculation of the moon's motion without the excessive labor which the earlier theories would have demanded. The newly awakened interest in celestial mechanics is made sufficiently evident by the fact that over twenty treatises and text-books have appeared during the last thirty years and these quite apart from scores of original memoirs.

Connected with this paper was the memoir on the motion of the perigee of the moon, in which the idea of a determinant with an infinite number of elements to solve an infinite system of linear equations was introduced and used as a powerful instrument for accurate computation. In the introduction written by Poincaré and printed in the first of the four volumes the latter says: "Avait-on le droit d'égaler à zéro le déterminant de ces équations? M. Hill l'a osé et c'était là une grande hardiesse; on n'avait jamais jusque-là considéré des équations linéaires en nombre infini; on n'avait jamais étudié les déterminants d'ordre infini; on ne savait même pas les définir et on n'était pas certain qu'il fût possible de donner à cette notion un sens précis." * * * "Mais il ne suffit pas d'être hardi, il faut que la hardiesse soit justifiée par le succès. M. Hill évita heureusement tous les pièges dont il était environné, et qu'on ne dise pas qu'en opérant de la sorte il s'exposait aux erreurs les plus grossières; non, si la méthode n'avait pas été légitime, il en aurait été tout de suite averti, car il serait arrivé à un resultat numérique absolument différent de ce que donnent les observations." But is there not something more than the mere numerical agreement? Does not intuition,

conscious or unconscious judgment, penetration into the heart of a matter—whatever we like to call it—play a large part in the selection of means to an end? It is not necessary—is it even advisable?—to stop and consider the theoretical possibilities of a new step if one feels certain it is to lead to the desired end, especially in the application of mathematics to physical problems. If astronomers had known that the series they were to use were nearly all divergent without at the same time knowing that they could still be used, would they have been inclined to undertake the enormous calculations which have resulted in our present tables for the positions of the moon and planets?

> The centipede was happy till
> One day the toad in fun
> Said, "Pray, which leg comes after which?"
> This raised his thoughts to such a pitch,
> He lay distracted in a ditch,
> Not knowing how to run.

At the same time, one does not in the least wish to depreciate the value of the labors of those, and above all of Poincaré himself, who have rendered such magnificent services to the cause of pure science by placing the methods of the applied mathematicians on a secure foundation.

In reading through the memoirs there are certain features of Dr. Hill's work which impress themselves on the mind. His power of dealing with long and complicated expressions with apparent ease is often the secret of his success. Unlike the methods in the two papers just mentioned which possess an excellent symmetry of mathematical form, expressions best adapted for computation are usually least symmetrical. And the reason for this is not difficult to understand. For the symmetry frequently implies some kind of relation between the symbols constituting the expression, which relation can often be used for abbreviating the work. In many cases one would shrink from attempting to reduce Dr. Hill's formulas to numbers, but he rarely fails to give one or more numerical examples to show how his methods can be applied. For instance, in memoir 79, which is an attempt to introduce the use of purely periodic terms to express the coordinates of the planets in terms of the time, instead of the usual method which involves secular terms, he estimates that some 2,800 special values of a certain expression will have to be computed. He immediately sets out the computation and the results for 175 of these to 13 places of decimals. And again, in the last paper on 'Dynamic Geodesy' in which he examines methods for computing the effects of the continents and seas in order to obtain a more accurate expression for the value of gravity at any place, there are five suppositions as to the distribution of the earth's mass; in each case the value of g and the deviation of the plumb line is found at several positions on the earth's surface.

The freshness and originality of Hill's work make it difficult to attach him to any particular school of mathematicians; if any such attempt is made, he belongs perhaps more closely to that of the mathematical astronomers of the latter part of the eighteenth century, and of their immediate successors. This is not unnatural, for it was to them that he owed his first inspiration. But his methods are essentially his own, even when he is expounding or using the work of his predecessors. We perhaps need more such men, lest the font of originality be choked up by the attempt to assimilate the mass of work which is being turned out every year in increasing quantities. That Dr. Hill has by no means ceased to contribute his share is shown by the last five papers contained in over a hundred pages which had not previously been published. The range of subjects is sufficiently varied. Two are continuations of memoir 79, to which reference has already been made; one is on the development of the disturbing function; one on the construction of maps, in which he sets forth a method for the better representation of large areas of the earth's surface or of the sky on paper; and the final one, also mentioned above, on geodesy.

It is to be regretted that the paper used for the reproduction is thick and unsized. In consequence of this the volumes are heavy and those who wish to make notes will find it necessary to use a sharp pencil rather than a

pen if the writing is to be legible. In other respects, the printing is good and clear, and wide margins are supplied.

In closing this brief notice, I can not do better than again to refer to the introduction. In the last paragraph, M. Poincaré says: "Ainsi aucune des parties de la Mécanique Céleste ne lui a été étrangère, mais son œuvre propre, celle qui fera son nom immortel, c'est sa théorie de la Lune; c'est là qu'il a été non seulement un artiste habile, un chercheur curieux, mais un inventeur original et profond. Je ne veux pas dire que ces méthodes qu'il a créées, ne sont applicables qu'à la Lune; je suis bien persuadé du contraire, je crois que ceux qui s'occupent des petites planètes seront étonnés des facilités qu'ils rencontreront le jour où en ayant pénétré l'esprit ils les appliqueront à ce nouvel objet. Mais jusqu'ici c'est pour la Lune qu'elles ont fait leurs preuves; quand elles s'étendront à un domaine plus vaste, on ne devra pas oublier que c'est à M. Hill que nous devons un instrument si précieux."

E. W. B.

Pocket-book of Aeronautics. By HERMANN W. L. MOEDEBECK in collaboration with O. CHANUTE and others. Authorized English edition translated by W. MANSERGH VARLEY. London, Whittaker & Co. 1907. Small 8vo. Pp. 496.

Moedebeck's 'Taschenbuck für Flugtechniker und Luftschiffer,' which first appeared in 1895 as a little volume of 198 pages, besides the ruled pages for entering observations, was intended to be carried in the pocket of the experimenter or aeronaut, and although a useful compendium it was hardly known outside Germany. A new and greatly enlarged edition (which renders the name 'pocket-book' inappropriate) has just been issued, and through the generous help of Patrick Alexander, an English gentleman interested in aeronautics, who cooperated with Mr. Chanute, the eminent Chicago engineer, the revised treatise has been made accessible to English readers.

The following summary of its contents will show the scope of this useful and timely handbook. Chapter I. deals with the gases used in filling balloons, and the next chapter, by Professor Kremser, a Berlin meteorologist, treats of the physics of the atmosphere. The observations in the free air quoted were, however, obtained in Europe and no reference is made to the large amount of data collected with kites in the United States by our Weather Bureau and at the Blue Hill Observatory, nor to the more recent observations with balloons at great heights, which were instituted by this observatory. The same writer, in Chapter III., gives practical directions for making and reducing balloon observations, but the translator has confused some of the meteorological symbols. In the next chapter Major Moedebeck discusses the technique of ballooning with which Chapter VI. on ballooning might properly have been combined. Kites and parachutes are treated in Chapter V. by the Hamburg meteorologist, Professor Köppen, who was one of the first persons in Europe to experiment with kites for meteorological purposes after their usefulness had been shown at Blue Hill in 1894. It may be said that neither figure 51*b* nor 53 represents a typical Hargrave kite, H. H. Clayton having invented this form with four continuous corner-sticks. Alexander Graham Bell's tetrahedral kite is omitted from the types described, notwithstanding the fact that the fame of the inventor has attracted wide attention to it. No mention is made of the practise of using larger wire for the lower portions of the line which enables great heights to be attained by attaching successive kites. The bibliography should include the important memoir by S. P. Fergusson, describing the perfected equipment at Blue Hill, which was published in *Annals of Harvard College Observatory,* Vol. 43, Part 3. In Chapter VII. balloon photography is discussed by Professor Miethe, an eminent authority, as is, in the following chapter by Professor Kutta, the allied subject of photographic surveying. Next comes a detailed account, by Major Moedebeck, of the history and present status of military ballooning in the different countries of the world. The editor's technical

knowledge of the subject gives authority to his estimate of the value of the future air-ship in warfare.

The remainder of the book is mainly devoted to dynamical aeronautics. Professor Müllenhoff analyzes briefly the principles of animal flight in Chapter X., and in the first part of the next one, Major Moedebeck gives the history of man's attempts at flight. In the same chapter a paper by the late Otto Lilienthal on artificial flight is followed by Mr. Chanute's account of the modern experiments where one looks in vain for any mention of the remarkable machines of the late Professor Langley. In Chapter XII. Major Moedebeck describes the air-ship or motor-balloon, in the list of whose performances, by some error, the drifting race of spherical balloons in 1906 for the Gordon-Bennett cup has been included, with the name of the winner strangely distorted. The next three chapters, on flying-machines, their motors and screws, are by the well-known Austrian expert, Major Hoernes. Chapter XVI., the last one, contains a convenient list of the aeronautical societies of the world and an appendix has a useful collection of tables and formulæ. The index is inadequate to so much material, but, in spite of this and some minor defects, the work can be highly recommended to the increasing number of persons interested in the investigation or navigation of the air, as the best existing treatise on this rapidly-developing subject.

A. Lawrence Rotch
Blue Hill Meteorological Observatory

SOCIETIES AND ACADEMIES

THE AMERICAN CHEMICAL SOCIETY. NORTHEASTERN SECTION

The seventy-seventh regular meeting of the section was held at the State Mutual Restaurant, Worcester, Mass., on May 18, at seven o'clock p.m. The paper of the evening was upon 'Ceramics,' by Dr. Frederic Bonnet, Jr. The speaker first referred to the importance of the clay-making industry, it being the third in magnitude and only surpassed by those of coal and iron. The value of clay products in 1905 reached the immense sum of $145,697,188. Of this, brick represent nearly one half. Clay consists of naturally occurring earthy materials having more or less plasticity when wet, and which, when heated to redness or higher, becomes hard and rocklike. Clays are of secondary origin, and are the product of the decomposition of feldspathic or serpentine rocks. Brongniart, and also Dr. Cushman, of the U. S. Department of Agriculture, testing laboratory for road materials, have made researches which indicate that the decomposition of the feldspar is a kind of electrolysis, in which the alkali constituent passes into solution, leaving the alumina and silica. The noted deposits of Cornwall, England, Zettlitz in Bohemia and certain deposits in Germany, however, appear to have resulted from the action of acid vapors on feldspar. Deposits formed by weathering are usually shallow and the original feldspar is found beneath. True kaolin is formed from feldspar and is essentially a basic hydrated aluminum silicate. If the clay has been transported by water and again deposited, it usually contains some impurities; if little iron is present and the clay is tough and plastic, it is called ball clay. The cause of plasticity is not fully understood and no entirely satisfactory theory has been advanced. One of the most recent, the colloid theory, fails to meet the case and does not explain the cohesiveness of a ball clay. The history of pottery is, to some extent, the history of man; from the crude pots of primitive races to the decorative ware and porcelain of advanced civilization. Clay is often used just as it is found for brick, tile and common pottery, but for all better ware it needs selection and preparation. In the finest ware and for some special purposes, it is subjected to very fine grinding and mixing, or long tempering and ageing. The effect of silica on the fusion point of clay is very important; pure kaolin fuses at temperatures about 1,800° C., or higher, but free silica lowers this, and hence should not be present in too great an amount in fire-clays. But metallic oxides are the most noticeable fluxes in clays; the fusion point decreases as the percentage of bases rises. But the bases exert this depressing effect on the fusion point in proportion to

their chemical equivalence; thus 40 MgO has the same lowering effect as 56 CaO, or 62 Na_2O. This is called the Law of Richter, but it does not apply to glazes where the amount of fluxes is large. Fusibility of clay is determined by test pieces (Seger cones), or by pyrometry. The Seger cones are made of pure clay, mixed with fluxes in such graded proportions that the fusion temperature of the consecutive numbers are about 20° C. apart. The No. I. cone fuses at the same temperature as an alloy of one part platinum and nine parts gold, *i. e.*, at 1,150° C. Since this temperature is rather high, Cramer and Hecht prepared cones containing B_2O_3 and PbO, fusing at definite temperatures down to 590° C. These cones give the true measure of the heat effect, but not necessarily the exact temperature, and hence are more useful to the potter than is the pyrometer, since they show the effect which will be produced on the ware. But cones do not show the temperature below 590° C., *e. g.*, at 200° to 400° C., when the water is given off from the clay, nor can they indicate anything as to the rate of cooling of a kiln, which is often important in reference to producing, or preventing crystallization of the glaze. The main difference between the glaze and the body of the ware is one of fusion temperature; the former fuses completely and is essentially a glass. A good glaze must have proper expansibility, to neither chip off nor crack (craze) upon the surface of the ware; and not be attacked by water or ordinary acids, especially for culinary ware, and must be hard to resist wear. The ordinary salt glaze on stoneware and the hard glaze on true porcelain meet all these conditions, but all other glazes fail in some degree. Four types of glaze are in common use: alkaline or salt glaze, feldspathic, lead, and stanniferous (enamels). The general formula for glaze is $xRO, yR_2O_3 \cdot zSiO_2$, where $RO =$ sum of metallic fluxes (CaO, MgO, K_2O, etc.); R_2O_3 is usually Al_2O_3 or the sum of Al_2O_3, Fe_2O_3, and Cr_2O_3; some of the SiO_2 may be replaced by TiO_2, SnO_2, etc. In the raw glaze, insoluble substances are finely ground and suspended in water, into which the ware is dipped. A fritted glaze has its materials partially fused and combined before grinding for the dipping. Thus a fritted glaze is made from soluble substances, or those of high specific gravity which would tend to segregate when the ware is dipped. The fusion of silicates results in the formation of igneous solutions holding the ingredients dissolved, and the temperature of fusion is lowest when several silicates are thus mixed. The more complex glazes and slags are the most fusible.

During the afternoon, before the meeting, parties were formed to visit the following manufacturing plants in Worcester: American Steel and Wire Company; Graton and Knight, Tannery and Leather-belting Company; the Worcester Sewage Plant; and the Polytechnic Institute Laboratories and Electrical Engineering Building. Later, the members of the Section were entertained at afternoon tea by Professor and Mrs. Leonard P. Kinnicutt at their home on Elm Street.

Specimens of various kinds of pottery were shown, among which were some from the Art Students' Club of Worcester, and examples of crystalline glazes from the New York State School of Ceramics, at Alfred.

Frank H. Thorp,
Secretary

THE TORREY BOTANICAL CLUB

The meeting of April 24, 1907, was called to order at the museum building of the New York Botanical Garden, at 3:40 P.M., with Dr. M. A. Howe in the chair. Twenty persons were present.

The following scientific program was presented:

Ecological Distribution of the Beach and Dune Flora about Chicago, Ill.: Miss Mary Perle Anderson.

Miss Anderson gave a brief account of the geological history of the ancient Lake Chicago and its succession of beaches, the Glenwood, the Calumet and the Toleston. These ancient beaches were formed by changes in the lake-level, and at the present time are indicated by ridges of wooded land more or less parallel to the present coastal beach of Lake

Michigan. The ridges are separated by the low level prairie land which makes up the Chicago Plain.

The formation of the dunes along the present shore of the head of Lake Michigan was considered, and also the changes in the flora that may be noted as one passes from the naked shifting dunes and extremely xerophytic conditions of those recently fixed, to the dunes farthest inland where mesophytic conditions prevail. Certain grasses, species of *Calamagrostis, Andropogon, Ammophila, Elymus,* do much to bind the dunes. The first trees to appear are the cottonwood and certain willows which are also of value in fixing the dunes. The scrub-oak and black-oak soon appear and are followed by the bur-oak, the white-oak, and the red-oak. *Pinus Banksiana* is followed by the white pine; the pig-nut hickory is succeeded by the shag-bark; other trees, such as the basswood, ash, cherry and black walnut, come in, and on the most mesophytic slopes of the oldest dunes and beaches one finds the sugar maple and, more rarely, the beech, hemlock, and southern tulip-tree. Corresponding changes in the shrubby and herbaceous vegetation occur, and at Stevensville and Porter, one may pass, in a short time, from extreme desert conditions through successive stages of the open forest of low trees and shrubs to the oak-hickory type and finally to the beech-maple-hemlock combination, which indicates the culmination of the forest in this region.

The usual ecological factors, heat, light, water, soil, wind, and direction of slope all have their influence in the floral distribution. Conditions in the dunes are extreme. Thus, for example, the trailing-arbutus and the bearberry, both northern types, may appear on the north-facing slope of a dune, while just over the crest, on the south-facing slope, the cactus may flourish.

Emphasis was laid on the fact that species vary with environment, often losing more or less of their xerophytic adaptations under mesophytic conditions; that a plant-society is only a stage in the development of a region; that the apparent tendency is for all to approach the mesophytic condition.

The paper was discussed by Dr. Grout and Dr. Rydberg.

Some Relations between Habitat and Structure in Mosses: Dr. A. J. GROUT.

Xerophytic mosses apparently tend to develop short, thick-walled cells, often with papillæ over the lumen. Nearly all mosses with papillæ over the lumen of the cell are xerophytic, or belong in groups that are largely xerophytic. Presumably the papillæ tend to retard transpiration.

Pleurocarpous mosses growing on trees tend to develop short thick-walled cells, especially at the basal angles, and a similarity of leaf structure in tree-growing mosses due to this fact has produced much of the confusion and uncertainty in classifying such mosses, *e. g., Alsia, Dendroalsia, Bestia, Groutia* and their relatives.

Tree-growing mosses also tend to develop erect capsules, and the correlated imperfect peristomes. To some extent this seems to apply to other xerophytic mosses.

Aquatic or subaquatic pleurocarpous mosses have an apparent tendency to develop enlarged and inflated alar cells.

Cleistocarpous and gymnostomous mosses appear, for the most part, to be mosses of various relationships adapted to damp soil, not closely covered with other vegetation, and best suited to support a rather short-lived annual moss.

The speaker recognized numerous exceptions to the above relationships, if stated as general principles, but, stated as tendencies, he believes they are worthy of serious consideration by the systematist, the morphologist, and the ecologist.

A brief discussion followed.

C. STUART GAGER,
Secretary

DISCUSSION AND CORRESPONDENCE

ELIMINATION OR FIRST SPECIES

HAVING followed the discussion of the proposed new rules of zoological nomenclature in the pages of SCIENCE, I feel that I voice the opinion of many zoologists when I say 'a plague o' both your houses.' For thirty years

I have been looking for fixity in zoological names, but that desirable condition seems further off than ever. It is all very well to indulge in these antiquarian researches, these games of taxonomic logomachy, if they be recognized as such, but the players fail to realize one thing: Names of animals and plants are but means for easy reference; nomenclature is not the end and object of all biological science.

The sanest word in all this discussion has, in my opinion, been said by Dr. Williston. This digging up of forgotten screeds means but the relegating of the great masters of the past to a secondary position; this framing of ex post facto laws offers a precedent for the future subject of that intolerable disease once known as the 'mihi itch' to set aside as lightly the laborious schemes of the sciolists of to-day.

Biologists may apparently be divided into two groups: One contains those who find great enjoyment in renaming things already well named and who regard names as the object of all science. The other group have something to tell us about animals and plants and they regard names merely as means of identification of the forms referred to. Certainly they have some rights which should be considered. Must they run through the gamut of *Triton, Triturus, Molge,* etc., every time the systematist changes his mind? Must I know the mental make-up—radical or conservative—of the biologist to know what he means when he refers to *Uca* or to *Acer saccharinum?* An article deals with *Esox;* does it treat of a pike or a needle fish?

The safest way for the morphologist or the ecologist is to stick to the well-accepted, time-honored names and to utterly ignore the vagaries of the nominalist. The question once was 'Who reads an American book?' If the present tendency continues it will soon be 'Who can read an American biological work?' It would be most desirable that at the coming Zoological Congress a morphologist or two should be added to the committee on nomenclature to act as a balance wheel.

J. S. Kingsley

A CORRECTION

To the Editor of Science: A statement on page 452 of Science of March 22 requires a rectification in the interest of the unprejudiced reader.

The sentence in question reads as follows:

> These results show conclusively that magnesium sulphate in proper dilution is beneficial to the growth of seedlings, and that any inhibitory effects are due to the presence of excessive amounts, thus controverting Loew's theory that magnesium salts when alone in solution are always injurious to plant growth.

Permit me the following remarks regarding this remarkable sentence:

1. It is not a *theory* that magnesium salts act poisonously on plants; it is a *fact*.

2. Not only Loew, but also others have observed the same fact. Loew has merely furnished an explanation well in accord with certain observations.

3. The doses at which magnesium salts, applied alone, are poisonous for plants can *impossibly* be called *excessive,* since even at 0.02 per cent. a poisonous action of magnesium salts on algæ can be observed, while calcium nitrate is not in the least injurious for algæ at even 1 per cent.

4. It is a well-known fact that many compounds that act poisonously at a certain concentration can act in very high dilution as stimulants of growth.

5. It is erroneous to attribute this stimulating action to any nutritive quality of the poison.

The unprejudiced reader who desires some information as to the nutritive rôle of magnesium salts in plants and to the conditions under which this function can be performed, is kindly requested to consult Bulletin No. 45 of the Bureau of Plant Industry, 'The Physiological Rôle of Mineral Nutrients in Plants,' Washington, 1903.

O. Loew

Imperial University of Tokyo, Japan,
April, 1907

SPECIAL ARTICLES

THE BEHAVIOR OF THE SEEDLINGS OF CERTAIN VIOLET HYBRIDS

During the summer of 1906 I raised plants from the seeds of twenty-five different hybrids

of *Viola,* and also from the seeds of about twenty pure species. The behavior of these two classes of seedlings was surprisingly unlike; the offspring of the pure species resembled each other closely, but the offspring of the hybrids were often much unlike each other and unlike their immediate parents, reverting in some qualities to one parent of the hybrid and in other qualities to the other parent, and this in a great variety of ways.

The species involved in these experimental cultures all belong to the group commonly known as 'blue stemless violets,' of which *V. palmata, V. cucullata* and *V. sagittata* are familiar examples. Of this group there are about twenty species in the northeastern United States. I may not repeat here the proof, published elsewhere,[1] that these closely allied species, when growing together, freely interbreed. I will merely say that the facts to be presented in the present paper furnish most positive confirmation of the opinion that these anomalous plants are hybrids.

One of the corollaries of Mendel's law is that each pair of contrasting characters in a hybrid works out its effects, for the most part, independently of all other pairs. As in Newton's 'Law of the Coexistence of Motion,' the final result is but the summing up of the various component movements taken separately. It will be simpler for us, therefore, in describing the behavior of violet hybrids, to consider each pair of characters by itself, taking up, in order, the divergence that occurs in respect to leaf-outline, in respect to pubescence, in respect to size, and lastly in respect to color of capsules and of seeds.

1. A striking illustration of diversity in leaf-form was seen in the offspring of *Viola cucullata* × *septemloba.* This hybrid was published by Mr. Bicknell in September, 1904, as a species, *V. notabilis.* It has been found in five different stations, always growing with the reputed parents. In June, 1904, I received from New Jersey one of these plants that I have grown now for three seasons. From its cleistogamous capsules, which of necessity give pure cultures, I collected seeds in 1905 that furnished the following summer ten vigorous plants. These bore in August and September an abundance of cleistogamous flowers that matured seeds; several plants bore also in the autumn petaliferous flowers.

The leaves of the parent species are very dissimilar, that of *V. cucullata* being broadly heart-shaped and pointed, that of *V. septemloba* (*V. Brittoniana*) primarily 3-parted, with the segments 2–4-lobed. The hybrids of these two species in all the five known stations exhibit a fair compromise in leaf-outline between the two quite unlike leaves of the parents, and closely resemble each other. They show about the same number of lobes as in *V. septemloba,* but the lobes are shorter and broader, the sinuses only half as deep. But in the offspring of this hybrid we have in addition to plants with this compromise leaf-form, plants with leaves but slightly lobed and showing the cordate base and acute apex of *V. cucullata,* and still other plants in which the leaf-outline is almost a complete reversion to *V. cucullata.* In the living plants that display, each, twelve or more leaves of these several patterns, the impression of dissimilarity is most striking.

Another marked case of diversity of leaf-outline in the progeny of the same hybrid was seen in *V. fimbriatula* × *septemloba.* This is Mr. Pollard's *V. Mulfordæ,* found first in 1902 at Hempstead Plains, Long Island. It has turned up during the past season in two other stations, but always in close proximity to the two parents. As before, the leaf of the hybrid is markedly intermediate between the very unlike leaves of the parent species; but not so with the leaves of several plants that I raised from this hybrid the past summer. The seedlings all came from the self-fertilized capsules of plants sent by Miss Mulford from the type station, but appeared most dissimilar in foliage, though growing side by side under the same cultural conditions. Some plants bore leaves like those of the parent hybrid; others bore leaves resembling those of *V. septemloba* in width, but those of *V. fimbriatula* in having only basal lobes; and still other plants were in leaf-pattern complete reversions to *V. fimbriatula.*

[1] See *Rhodora,* VI., 213–223; VIII., 6–10, 49–60.

2. I would speak, secondly, of diversity in hybrid seedlings as respects pubescence. When one parent is pubescent and the other glabrous, the hybrids of the first generation, such as we usually find in the field, are as a rule intermediate in this character, being *somewhat* pubescent. In certain large colonies, where the plants appear to have been long established, and to have produced offspring, we find notable reversions. I have visited several stations where *V. fimbriatula* and *V. sagittata* grew in abundance, and where many plants were to be seen having the leaf-outline of *V. fimbriatula* with the glabrous character of *V. sagittata;* and conversely, many having the leaf-outline of *V. sagittata* with the hairiness of *V. fimbriatula.* Among cultivated seedlings of hybrids this reversion was seen in *V. fimbriatula* × *septemloba,* referred to above. The plants from Long Island and from Connecticut are all more or less pubescent; but among the five seedlings that I raised from the Long Island plant, two that in leaf-outline revert to *V. fimbriatula* are quite as glabrous as *V. septemloba,* retaining only the fine ciliation that appears on the margin of the leaves in both these species.

3. As respects diversity in size, I have a notable instance in the seedlings of *V. papilionacea* × *villosa,* two species that are respectively the largest and the smallest plants of the group. The mother plant was collected near Philadelphia by Mr. Witmer Stone. The five seedlings that I raised from it grew side by side under the same external conditions; but three of the plants had leaves twice as broad as the leaves of the other two.

4. One more particular in which I have found hybrid seedlings of *Viola* to differ from one another is in the color of the seeds and of the cleistogamous capsules. In about one half the species of this group these capsules are commonly blotched or dotted with purple. The hybrid of any of these with a green-fruited species bears ordinarily a capsule of an intermediate color. But in the offspring of the hybrid the capsule is frequently seen to have the pure green of the one grandparent, or the normal purple of the other.

But this color reversion is more strikingly exhibited in the behavior of the seeds of some of these hybrid offspring. Our species of 'blue stemless violets' vary much in the color of the seeds; and these colors are quite constant in the same species, as seen in specimens growing a thousand miles apart. For example, *V. cucullata* and *V. papilionacea* have dark brown, almost black, seeds; *V. fimbriatula* has nut-brown seeds; *V. affinis, V. villosa*[3] and *V. septemloba* seeds of a light straw-color. Now, when two species with different colored seeds are crossed, the color of the seeds of the first-cross is usually a mean between the colors of the parents. In a hybrid from Ivy Hill Cemetery, Philadelphia, black-seeded *V. papilionacea* is crossed with pale-seeded *V. villosa,* and produces brown seeds. But in seven plants raised from these brown seeds, four had the dark-colored seeds of *V. papilionacea* and three the light-colored seeds of *V. villosa.* In five seedlings of one plant of *V. affinis* × *cucullata,* two bore seeds quite as pale as those of *V. affinis;* the remaining three, however, bore not the black seeds of the other grandparent, but the brown seeds of the mother-hybrid. This divergence in seed-color also appears in the seedlings of the two hybrids used to illustrate diversity in leaf-pattern. In ten seedlings of *V. cucullata* × *septemloba,* four ripened dark-colored seeds; six, light-colored seeds. In five seedlings of *V. fimbriatula* × *septemloba,* three bore the brown seeds of *fimbriatula* and two the straw-colored seeds of *V. septemloba.*

I am not yet able to state definitely what proportion of violet hybrids produce heterogeneous offspring. In some cases the number of plants raised was too small to admit of a satisfactory conclusion regarding this tendency. But in several instances there were strong indications that the hybrid was stable, and produced offspring quite like itself. The most noteworthy instance was that of *V. affinis* × *septentrionalis,* of which I raised twenty-four seedlings in 1904, and the past season from the seeds of these, many plants of a third generation. The meager pubes-

[3] The species here referred to is the *V. villosa* of recent authors, which is probably not *V. villosa* Walter.

cence, the brown seeds, the impaired fertility of the original hybrid plant, have remained unchanged.

Such behavior is by no means rare among blend-hybrids in other genera than *Viola*. Willow hybrids, for example, are said to produce stable offspring always like the parent hybrid. Dr. MacDougal states[3] that "more than a thousand such fixed hybrids or hybrid species are known." In fact, de Vries is of the opinion that this procedure takes place in all hybrids between pure species—that is, species that differ from each other by no 'varietal' character. In such hybrids the differences of the parents are so thoroughly blended, that they do not disunite in the germ-cells, as in hybrids governed by the law of Mendel, and therefore the offspring simply repeat the form of the parent hybrid.

One further observation is of interest—a tendency in certain individual seedlings to recover from the marked impairment of fertility that characterizes nearly all violet hybrids. It is well known that partial or complete sterility is usually found in a hybrid, when the parent forms differ from each other in several or many characters; but that when the differences are few, especially when only one or two (as often between a species and its variety), there is seldom any loss of fertility. We are further taught by Mendel's law, that when the parents of the first cross differ in more than one character, the majority of the offspring will be hybrid in fewer characters than the parent; in fact, if the offspring be sufficiently numerous, there will be found a certain percentage[4] of forms that have no hybrid character, but various combinations of the pure characters of the two parents; and such forms, though often new, will prove stable when reproduced by self-fertilized seed. With this diminution, or entire loss of hybridity, we should naturally expect a partial or total recovery from the impairment of fertility produced in the first-cross. At any rate, it is an observed fact that many violet seedlings, whose hybrid parents produced seed from only about one tenth of their ovules, are themselves normally fertile.

We have, then, in our blue stemless violets a rather large group of closely allied species that freely interbreed, producing 'blend-hybrids,' that is, hybrids in which the differences of the parents appear in a compromise form. While it may occur in *Viola*, there has been observed no instance of what Mendel calls 'dominance'—the appearance in the hybrid in full force of a character of one of the parents to the suppression of the contrasting character of the other parent. Even differences in respect to pubescence, or in respect to color of capsules or of seeds, are in violet hybrids represented in an intermediate condition, though these differences in other genera usually give rise to dominance.

Nevertheless, in the behavior of their offspring many violet hybrids obey the Mendelian law of segregation. The compromise effected in the sporophyte stage between the conflicting characters of the parentage, is annulled when the plant passes into the gametophyte stage; the germ-cells are for the most part pure, and the offspring heterogeneous, consisting of reversions to the original species, of new and stable forms, and of various hybrid forms. This is by no means a novel phenomenon in the history of hybridism. Professor Castle says,[5] "dominance is purely a secondary matter; it may, or may not, occur along with segregation." Professor Bateson says,[6] "the applicability of the Mendelian hypothesis has, intrinsically, nothing to do with the question of the inheritance being blended or alternative." Numerous instances might be cited; but it may be questioned, if in any other group of plants the phenome-

[3] 'Heredity, and the Origin of Species,' p. 8.

[4] The average ratio of such forms to the whole number of offspring is expressed by the fraction $\frac{1}{2^n}$ where n is the number of differences between the parents of the first cross; this fraction also expresses the proportion of the forms that exactly resemble the parent hybrid; the remainder, or the offspring with reduced hybrid characters, will be, respectively, 0, $\frac{1}{2}$, $\frac{3}{4}$, $\frac{7}{8}$, $\frac{15}{16}$, etc., when the differences of the grandparents are, respectively, 1, 2, 3, 4, 5, etc.

[5] Mark Anniversary Volume, p. 383.

[6] 'Mendel's Principles of Heredity,' Smithsonian Report, 1902, p. 574.

non is more extensively and clearly exhibited than in *Viola*.

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FORMULAS FOR THE COMPARISON OF ASTRONOMICAL PHOTOGRAPHS

THE present paper contains formulas suitable for the direct comparison of rectangular coordinates measured on different astronomical negatives. The problem here involved supplements what may be called the fundamental transformations in the reduction of celestial photographs; *viz.*, the calculation of right-ascensions and declinations from rectangular coordinates, and rectangular coordinates from right-ascensions and declinations. The writer has published formulas for all these transformations in 'Tables for the Reduction of Astronomical Photographs,' Contrib. Obs. Col. Univ., No. 23. In these formulas the problem is solved by expansion into series, taking advantage of the fact that the photographs under consideration cover but a very small part of the sky, so that measured coordinates may be regarded as small quantities.

It is sometimes desirable to compare rectangular coordinates of the same stars measured on two different overlapping photographs without computing right ascensions and declinations. For instance, Donner used this method for strengthening his determination of plate-constants in his reduction of the astrophotographic catalogue plates ('Sur le Rattachement des clichés astrophotographiques,' *Acta Soc. Sci. Fenn.*, Tom XXI., No. 8). Another important application will doubtless occur in the calculation of the solar parallax from Eros observations by the diurnal method.

For these reasons, the writer has thought it desirable to expand directly the x and y of a star on one plate in terms of its x and y on a second plate. The resulting series, though clumsy in appearance, are rapidly convergent, and in most practical cases, convenient in use. As here given, all terms to the fifth order, inclusive, have been retained; but a table is attached to the formulas showing the declination at which any term may be omitted in actual applications of the method. When this declination is greater than 75°, the table contains the number 75+. Inasmuch as we require a precision of 0″.01 up to 75° declination, the table has been arranged so as to exclude only terms less than 0″.005.

To obtain the desired expansions, we let:

x_1, y_1, be the coordinates of a star on a correctly oriented plate whose center corresponds to the right-ascension α_1 and declination δ_1 on the sky.

x_2, y_2, be the coordinates of the same star on a second correctly oriented plate whose center corresponds to the right-ascension α_2 and declination δ_2 on the sky.

M_1, M_2, . . . N_1, N_2, . . . be certain auxiliary quantities, constant for all stars on a given pair of plates.

If we now put:

$$d\alpha = \alpha_1 - \alpha_2, \quad d\delta = \delta_1 - \delta_2, \quad \delta = \tfrac{1}{2}(\delta_1 + \delta_2),$$

we can express x_2, y_2, in terms of x_1, y_1, as follows:

$$(1)\quad \begin{cases} x_2 = x_1 + M_1 + M_2x_1 + M_3y_1 + M_4x_1^2 + M_5x_1y_1 \\ \qquad + M_6y_1^2 + M_7x_1^3 + M_8x_1^2y_1 + M_9x_1y_1^2, \\ y_2 = y_1 + N_1 + N_2x_1 + N_3y_1 + N_4x_1^2 + N_5x_1y_1 \\ \qquad + N_6y_1^2 + N_7x_1^2y_1 + N_8x_1y_1^2 + N_9y_1^3. \end{cases}$$

Expressions for the M's and N's, with the table mentioned above, are given at the end of the present paper. The writer is under special obligations to Mr. G. W. Hartwell, assistant in mathematics, Columbia University, for help in this part of the work. Demonstrations are omitted here, because the formulas can be verified satisfactorily by means of a numerical example, such as the following particularly unfavorable one. Let us assume two plates and an imaginary star such that:

$\alpha_1 = 0^\circ\ 0'\ 0''.00$,	$\alpha_2 = 2^\circ\ 0'\ 0''.00$,
$\delta_1 = 74^\circ\ 0'\ 0''.00$,	$\delta_2 = 75^\circ\ 0'\ 0''.00$,
$x_1 = +\ 3600''$,	$\delta = 74^\circ\ 30'\ 0''.00$.
$y_1 = +\ 3600''$,	

The right ascension and declination of the imaginary star, which we will call A and D, can then be computed readily from x_1, y_1, α_1, δ_1, by means of our former series published in Contrib. Obs. Col. Univ., No. 23.

VALUES OF *M*'S AND *N*'S, WITH LIMITING DECLINATIONS.

	Decl. at which Term can amount to 0".005					
	$x_1 = 30'$, $y_1 = 30'$			$x_1 = 1^\circ$, $y_1 = 1^\circ$		
	$da \cos\delta = 10'$ $d\delta = 10'$	30' 30'	1° 1°	10' 10'	30' 30'	1° 1°
$M_1 = + da \cos\delta$	0°.0	0°.0	0°.0	0°.0	0°.0	0°.0
$- 1/2\, da \cos\delta\, d\delta\, \delta \tan \sin 1''$	0.3	0.0	0.0	0.3	0.0	0.0
$+ 3/8\, da \cos\delta\, d\delta^2 \sin^2 1''$	75+	0.0	0.0	75+	0.0	0.0
$- 1/6\, da^3 \cos^3\delta\, (\tan^2\delta - 2) \sin^2 1''$	70.4	0.0	0.0	70.4	0.0	0.0
$- 11/48\, da \cos\delta\, d\delta^3 \tan\delta \sin^3 1''$	75+	75+	48.7	75+	75+	48.7
$+ 1/12\, da^3 \cos^3\delta\, d\delta \tan\delta\, (\tan^2\delta - 2) \sin^3 1''$	75+	75+	62.3	75+	75+	62.3
$+ 19/128\, da \cos\delta\, d\delta^4 \sin^4 1''$	75+	75+	75+	75+	75+	75+
$- 1/16\, da^3 \cos^3\delta\, d\delta^2 (3 \tan^2\delta - 4) \sin^4 1''$	75+	75+	75+	75+	75+	75+
$+ 1/120\, da^5 \cos^5\delta\, (16 - 13 \tan^2\delta + \tan^4\delta) \sin^4 1''$	75+	75+	75+	75+	75+	75+
$M_2 = + 1/2\, d\delta^2 \sin^2 1''$	0.0	0.0	0.0	0.0	0.0	0.0
$- 1/2\, da^2 \cos^2\delta\, (\tan^2\delta - 2) \sin^2 1''$	0.0	0.0	0.0	0.0	0.0	0.0
$- 1/8\, da^2 \cos^2\delta\, d\delta^2 (5 \tan^2\delta - 7) \sin^4 1''$	75+	75+	75+	75+	75+	75+
$+ 1/24\, da^4 \cos^4\delta\, (\tan^4\delta - 13 \tan^2\delta + 16) \sin^4 1''$	75+	75+	75+	75+	75+	75+
$+ 5/24\, d\delta^4 \sin^4 1''$	75+	75+	75+	75+	75+	75+
$M_3 = - da \cos\delta \tan\delta \sin 1''$	0.1	0.0	0.0	0.0	0.0	0.0
$+ 1/2\, da \cos\delta\, d\delta \sin^2 1''$	0.0	0.0	0.0	0.0	0.0	0.0
$- 7/8\, da \cos\delta\, d\delta^2 \tan\delta \sin^3 1''$	75+	75+	30.8	75+	67.3	16.6
$+ 1/6\, da^3 \cos^3\delta \tan\delta\, (\tan^2\delta - 5) \sin^3 1''$	75+	74.0	34.7	75+	71.7	17.7
$- 1/12\, da^3 \cos^3\delta\, d\delta\, (\tan^2\delta - 5) \sin^4 1''$	75+	75+	75+	75+	75+	75+
$+ 23/48\, da \cos\delta\, d\delta^3 \sin^4 1''$	75+	75+	75+	75+	75+	75+
$M_4 = da \cos\delta \sin^2 1''$	0.0	0.0	0.0	0.0	0.0	0.0
$+ 1/2\, da \cos\delta\, d\delta \tan\delta \sin^3 1''$	75+	75+	64.4	75+	64.4	27.6
$+ 7/8\, da \cos\delta\, d\delta^2 \sin^4 1''$	75+	75+	75+	75+	75+	75+
$- 2/3\, da^3 \cos^3\delta\, (\tan^2\delta - 2) \sin^4 1''$	75+	75+	75+	75+	75+	75+
$M_5 = d\delta \sin^2 1''$	0.0	0.0	0.0	0.0	0.0	0.0
$- 3/2\, da^2 \cos^2\delta \tan\delta \sin^3 1''$	75+	70.3	34.9	75+	34.9	9.9
$+ 5/6\, d\delta^3 \sin^4 1''$	75+	75+	75+	75+	75+	75+
$- 1/4\, da^2 \cos^2\delta\, d\delta\, (5 \tan^2\delta - 7) \sin^4 1''$	75+	75+	75+	75+	75+	74.7
$M_6 = - da \cos\delta\, d\delta \tan\delta \sin^3 1''$	75+	75+	46.3	75+	46.3	14.6
$+ 1/2\, da \cos\delta\, d\delta^2 \sin^4 1''$	75+	75+	75+	75+	75+	75+
$+ 1/2\, da^3 \cos^3\delta \tan^2\delta \sin^4 1''$	75+	75+	75+	75+	75+	75+
$M_7 = 1/6\, da^2 \cos^2\delta\, (\sec^4\delta + 6) \sin^4 1''$	75+	75+	75+	75+	75+	70.7
$M_8 = 2\, da \cos\delta\, d\delta \sin^4 1''$	75+	75+	75+	75+	75+	75+
$M_9 = d\delta^2 \sin^4 1''$	75+	75+	75+	75+	75	75+
$N_1 = d\delta$	0.0	0.0	0.0	0.0	0.0	0.0
$+ 1/2\, da^2 \cos^2\delta \tan\delta \sin 1''$	0.3	0.0	0.0	0.3	0.0	0.0
$- 1/4\, da^2 \cos^2\delta\, d\delta\, (\tan^2\delta - 1) \sin^2 1''$	65.8	0.0	0.0	65.8	0.0	0.0
$+ 1/3\, d\delta^3 \sin^2 1''$	75+	0.0	0.0	75+	0.0	0.0
$+ 1/4\, da^2 \cos^2\delta\, d\delta^2 \tan\delta \sin^3 1''$	75+	75+	46.3	75+	75+	46.3
$- 1/24\, da^4 \cos^4\delta \tan\delta\, (\tan^2\delta - 5) \sin^3 1''$	75+	75+	69.7	75+	75+	69.7
$+ 1/48\, da^4 \cos^4\delta\, d\delta\, (\tan^4\delta - 6 \tan^2\delta + 5) \sin^4 1''$	75+	75+	75+	75+	75+	75+
$+ 2/15\, d\delta^5 \sin^4 1''$	75+	75+	75+	75+	75+	75+
$N_2 = da \cos\delta \tan\delta \sin 1''$	0.1	0.0	0.0	0.0	0.0	0.0
$+ 1/2\, da \cos\delta\, d\delta \sin^2 1''$	0.0	0.0	0.0	0.0	0.0	0.0
$+ 7/8\, da \cos\delta\, d\delta^2 \tan\delta \sin^3 1''$	75+	75+	30.8	75+	67.3	16.6
$- 1/6\, da^3 \cos^3\delta \tan\delta\, (\tan^2\delta - 5) \sin^3 1''$	75+	74.0	34.7	75+	71.8	17.9
$- 1/12\, da^3 \cos^3\delta\, d\delta\, (\tan^2\delta - 5) \sin^4 1''$	75+	75+	75+	75+	75+	75+
$+ 23/48\, da \cos\delta\, d\delta^3 \sin^4 1''$	75+	75+	75+	75+	75+	75+

VALUES OF M'S AND N'S, WITH LIMITING DECLINATIONS.

	Decl. at which Term can amount to 0''.005					
	$x_1 = 30'$, $y_1 = 30'$			$x_1 = 1°$, $y_1 = 1°$		
	$da \cos\delta = 10'$ $d\delta = 10'$	30' 30'	1° 1°	10' 10'	30' 30'	1° 1°
$N_3 = -1/2\, da^2 \cos^2\delta\, (\tan^2\delta - 1) \sin^2 1''$	0°.0	0°.0	0°.0	0°.0	0°.0	0°.0
$+ d\delta^2 \sin^2 1''$	0.0	0.0	0.0	0.0	0.0	0.0
$- 3/4\, da^2 \cos^2\delta\, d\delta^2 (\tan^2\delta - 1) \sin^4 1''$	75+	75+	75+	75+	75+	75+
$+ 1/24\, da^4 \cos^4\delta\, (\tan^4\delta - 12\tan^2\delta + 5) \sin^4 1''$	75+	75+	75+	75+	75+	75+
$+ 2/3\, d\delta^4 \sin^4 1''$	75+	75+	75+	75+	75+	75+
$N_4 = da^2 \cos^2\delta \tan\delta \sin^3 1''$	75+	75+	46.3	75+	46.3	14.6
$+ 1/2\, da^2 \cos^2\delta\, d\delta \sec^2\delta \sin^4 1''$	75+	75+	75+	75+	75+	75+
$N_5 = da \cos\delta \sin^2 1''$	0.0	0.0	0.0	0.0	0.0	0.0
$+ 3/2\, da \cos\delta\, d\delta \tan\delta \sin^3 1''$	75+	70.3	34.9	75+	34.9	9.9
$+ 15/8\, da \cos\delta\, d\delta^2 \sin^4 1''$	75+	75+	75+	75+	75+	75+
$- 1/6\, da^3 \cos^3\delta\, (7\tan^2\delta - 5) \sin^4 1''$	75+	75+	75+	75+	75+	74.8
$N_6 = d\delta \sin^2 1''$	0.0	0.0	0.0	0.0	0.0	0.0
$- 1/2\, da^2 \cos^2\delta \tan\delta \sin^3 1''$	75+	75+	64.4	75+	64.4	27.6
$- 3/4\, da^2 \cos^2\delta\, d\delta\, (\tan^2\delta - 1) \sin^4 1''$	75+	75+	75+	75+	75+	75+
$+ 4/3\, d\delta^3 \sin^4 1''$	75+	75+	75+	75+	75+	75+
$N_7 = 1/8\, d\delta^2 (3\tan^4\delta - 2\tan^2\delta - 1) \sin^4 1''$	75+	75+	75+	75+	74.4	68.8
$+ da^2 \cos^2\delta \sin^4 1''$	75+	75+	75+	75+	75+	75+
$N_8 = 2da \cos\delta\, d\delta \sin^4 1''$	75+	75+	75+	75+	75+	75+
$N_9 = d\delta^2 \sin^4 1''$	75+	75+	75+	75+	75+	75+

We find them to be:

Right ascension, $A_1 = 3° 51' 26''.08$,
Declination, $D_1 = 74° 58' 2''.52$.

From A, D, a_2, δ_2, we now compute x_2, y_2, also by our former series. These come out:

$$x_2 = +1733''.92, \qquad y_2 = -90''.28.$$

If we now apply equations (1) of the present paper to the data a_1, δ_1, a_2, δ_2, x_1, y_1, we should arrive at the same values of x_2, y_2. Actual calculation of the expressions appended below gives:

	''		''
x_1	$= +3600.000$	y_1	$= +3600.000$
M_1	$= -1984.573$	N_1	$= -3567.062$
$M_2 x_1$	$= -1.176$	$N_2 x_1$	$= -120.818$
$M_3 y_1$	$= +121.404$	$N_3 y_1$	$= -0.783$
$M_4 x_1^2$	$= -0.568$	$N_4 x_1^2$	$= +0.020$
$M_5 x_1 y_1$	$= -1.126$	$N_5 x_1 y_1$	$= -0.531$
$M_6 y_1^2$	$= -0.037$	$N_6 y_1^2$	$= -1.107$
$M_7 x_1^3$	$= +0.003$	$N_7 x_1^2 y_1$	$= +0.020$
$M_8 x_1^2 y_1$	$= 0.000$	$N_8 x_1 y_1^2$	$= 0.000$
$M_9 x_1 y_1^2$	$= 0.000$	$N_9 y_1^3$	$= 0.000$
	$x_2 = +1733.927$		$y_2 = -90.261$

These numbers are in satisfactory accord with the values obtained in the previous calculation with the old series.

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CURRENT NOTES ON LAND FORMS

UPWARPED MOUNTAINS IN ALASKA

The descriptions of certain ranges given by A. H. Brooks in 'The Geography and Geology of Alaska' (prof. paper no. 45, U. S. Geol. Survey, 1906) furnish additional examples of upwarped plateaus, carved into mountainous form by normal and glacial erosion, as already indicated in Gilbert's volume on 'Glaciers' in the reports of the Harriman Alaskan Expedition. The coast range, or southeastern part of the Pacific mountain system in Alaska, is said to be an irregular aggregate of mountain masses with little symmetry of arrangement except a rough alignment along a northwest-southeast axis. The whole aspect of the range is rugged and precipitous, from the needle peaks and knife-edge crests down to the sharply incised channels. This young

topography appears to have been carved out of an ancient highland, as is indicated by the striking uniformity of the summit altitudes, which range from about 7,500 feet in British Columbia to about 5,000 feet in Alaska. Here and there pyramidal peaks rise above the general sky line, as if representing the fast-disappearing remnants of eminences not reduced to the general regional level in an earlier cycle of erosion. The Endicott range, the most important member of the Rocky mountain province in Alaska, appears to have had a similar history. When viewed from altitudes of 6,000 feet, the summits 'show a remarkably even sky-line and strongly suggest that they have been carved from a former plateau.' Here, while the transverse valleys are sharply cut, the longitudinal valleys are broad with gentle slopes. The Central plateau, between the Endicott and the Pacific ranges, is described as a gently rolling upland in which the rivers have trenched broad valleys; occasional mountains or mountain groups break the continuity of the plateau. All these provinces appear to have been eroded to moderate relief during a lower stand of the land; the contrasts that they now present seem to be due in part to difference in the amount of uplift, and in part to difference in the depth and stage of revived erosion. Although the ranges here considered do not possess even-topped summits, such as occur in certain other mountain ranges lately referred to in these notes, they appear with many others to confirm the law to which Powell gave so much emphasis: that plateaus of uplift are fashioned into mountains by rivers and glaciers.

I. B.

THE WOLDS AND VALES OF BELTED COASTAL PLAINS

THE development of longitudinal belts of higher and lower ground in a coastal plain (or other similar structure) that initially possessed a single continuous transverse slope toward the sea, is a question to which systematic attention has been given but recently in books on physical geography. A terminology appropriate for the description of longitudinal relief of this kind has lately been suggested by A. C. Veatch in connection with the examples that occur in New Jersey and Long Island ('Underground Water Resources of Long Island, N. Y.,' prof. paper 44, U. S. Geol. Survey, 1906, 28–32). He introduces the English terms, *wold* and *vale;* wold, for the upland which is sustained on a belt of more resistant strata; and vale, for the longitudinal depression that is excavated, chiefly by subsequent streams, on a belt of weaker strata. Thus he calls the inner lowland in New Jersey the Hightstown vale; and the enclosing upland the Perrineville wold; the former having its northeastward extension submerged in Long Island Sound; and the latter forming the body of Long Island itself, now ornamented with glacial additions. In this connection, an ingenious explanation is offered for the deflection of the Delaware, Susquehanna and Potomac rivers for short distances southwestward along the vale, before they transect the wold: Direct consequent courses are assumed to have prevailed in the first cycle of coastal-plain erosion (in which the small relief of old age was presumably attained); then during a time of depression, the transverse passages through the wold were obstructed by Lafayette deposits; and on reelevation—probably with a slight tilt to the southwest—the three rivers deserted their former transverse notches and sought new ones. The problem is necessarily an obscure one, because of the large amount of erosion since the deflected courses were taken. Darton (and later, Newsom) had previously explained these cases of river deflection as caused by coastal sand reefs during a time of submergence; but Veatch points out that this would not account for the occurrence of deflection only in those rivers where a vale had been eroded on weak Cretaceous beds.

In my own practise, the forms here designated by wold and vale have been called cuesta and (inner) lowland. Objection has been frequently urged against the Spanish word, cuesta, because it does not mean only a lop-sided ridge, but a hill or slope of any kind. To this my answer has been that, as soon as any other fitting term comes to be generally

adopted, the Spanish name may be given up; but that in the meantime cuesta is much better than no name at all. It will now be interesting to note what acceptance is gained, especially in England, by wold and vale in the restricted sense proposed by Veatch; and to know how many American physiographers will say 'Chunnenugga wold' and 'Winnebago vale' for the cuesta of southern Alabama and the inner lowland of eastern Wisconsin. 'Wold,' like 'forest,' originally meaning wild-land, but not necessarily wood-land, is taken from eastern England, where it names the lop-sided ridge of chalk which ends at Flamboro head; but the chalk cuesta elsewhere in England has other names, such as Chiltern 'Hills,' near Oxford, and the North and South 'downs,' on either side of the eroded lowland of the Weald (another form of wold): and 'vale' is used in England not only for lowlands of the kind here considered, but also for the Vale of Eden, eroded on a faulted mass next west of the Pennine escarpment; and for the Vale of Pewsey, an anticlinal valley. It is perhaps as doubtful whether English physiographers will be content to use these semi-poetic terms in the limited systematic sense proposed by Veatch, as whether Spanish physiographers (if such there be) will be satisfied with the foreign use of cuesta for a low lop-sided ridge.

W. M. D.

SOUTHERN ARKANSAS AND NORTHERN LOUISIANA

THE inner part of the coastal plain in the Gulf States is well known to be a hilly district, but it is not often that one meets specific and systematic accounts of its topographic features. A few pages of welcome information on this matter are found in a recent report by A. C. Veatch ('Geology and Underground Water Resources of Northern Louisiana and Southern Arkansas,' prof. paper 46, U. S. Geol. Survey, 1906, 14–16), where the hill lands between the broad flood plains of the Mississippi, Ouachita, Red and Sabine rivers are described as traversed (ENE–WSW) by several 'ranges of hills, which are more or less persistent for many miles and which follow the general strike of the formations producing them.' The ranges and the strike valleys between them are called wolds and vales, according to the terminology referred to in the preceding note. The Kisatchie wold, formed on the Catahoula (Grand Gulf) formation in northwestern Louisiana, is perhaps the most important. According to McGee it is continued southeastward through the state of Mississippi as the 'Grand Gulf hill land'; and it is due to this wold-making formation that the Mississippi flood plain is narrowed and its enclosing bluffs are increased in height near Natchez ('Lafayette Formation,' 12th Ann. Rep. U. S. Geol. Survey, 1891, 366–370). Sulphur wold, formed on the sandy beds of the lower Eocene, extends from southwestern Arkansas into Texas: between its inner face and the next (Saratoga) wold, farther inland, is a vale along which a main railway line runs from Little Rock. Sulphur wold would appear to be the trans-Mississippi representative of what is known in Alabama as the Chunnenugga ridge (best described by E. A. Smith, Geol. Surv., Alabama, Rep. for 1881–2, p. 273), and in Mississippi as the 'Lignitic hill lands' (see McGee, as above). The wolds, cuestas or hill lands of Arkansas and Louisiana are not continuous upland belts, but are maturely dissected into gentle hills and open valleys by consequent and insequent streams (subsequent streams are poorly developed), with a relief of 100 or 200 feet.

The peculiar shallow lakes which once occupied the valleys lateral to that of the Red river of Louisiana are described with care (pp. 59–64). The explanation which attributes them to obstruction by normal though rapid aggradation of the main-river flood-plain is shown to be in error. They are due to the obstruction of the main river by its 'raft,' or jam of fallen trees. The raft grew by gradual addition to its upper end, while its downstream end slowly decayed and drifted away. As one tributary stream after another was thus obstructed, a shallow lake rose in the lateral valleys. The raft has been artificially removed (1873) by cutting away the tree trunks; and since then the river has lowered its bed and the lakes have shrunk or disappeared. They are given too great number and

size on most maps. The deflection of the Red river by the raft to the northeast side of its flood plain, and the resulting development of rapids, not yet graded, where it turns by a new course into the Mississippi flood-plain are items worth mention.

The lakes on the tributaries of the Danube near its mouth have, like those lateral to the Red river of Louisiana, been explained as due to aggradation of the main-river flood-plain. In view of the above restatement of the problem of the Red river lakes, that of the Danube lakes also may require a new interpretation.

W. M. D.

THE BICENTENARY OF LINNÆUS

THE trustees of the British Museum have deputed one of their officers, Dr. F. A. Bather, assistant keeper of the geological department, to represent the museum at the celebrations in Sweden of the bicentenary of the birth of Linnæus. Dr. Bather has been instructed to present two addresses to the University of Upsala and the Swedish Academy of Sciences, the former of which reads as follows:

The British Museum (Natural History), London.
To the Royal University of Upsala.

It is with feelings of peculiar indebtedness that the Board of Trustees of the British Museum desires on this occasion to greet and congratulate the University of Linnæus.

In January, 1758, was published the tenth edition of the 'Systema Naturæ,' the edition from which the zoologists of the world now date the technical nomenclature of animals. In January, 1759, the British Museum was first opened to the public, and its Natural History Departments began the systematic study of the living and extinct animals and plants, taking for their guidance the works of Linnæus, and for their teacher his favorite pupil, Daniel Charles Solander.

By the acquisition of the Banksian Herbarium and Library, already brought to such perfection of arrangement by Solander and Jonas Dryander, the British Museum became the repository of many plants described by Linnæus, notably the originals of the celebrated 'Hortus Cliffortianus,' as well as of valuable manuscripts and books connected with the great Swede.

Desiring, therefore, to share in your celebration of one to whom the British Museum owes so much, the Trustees beg to join with this letter 'A Catalogue of the Works of Linnæus Preserved in the Libraries of the British Museum,' which they have had specially printed in honor of this occasion, and they have appointed as their delegate to present the same one of their officers, Dr. Francis Arthur Bather, M.A.Oxon, Assistant Keeper of the Geological Department.

May the world-wide fame of Linnæus and the fortune of the ancient University of Upsala ever endure and increase to the advancement of learning and the benefit of mankind!

EDWIN RAY LANKESTER,
Director

BRITISH MUSEUM (NATURAL HISTORY),
May 11

SCIENTIFIC NOTES AND NEWS

M. DE LAPPARENT, professor of mineralogy and geology at Paris, has been elected permanent secretary of the Paris Academy of Sciences in succession to the late M. Berthelot.

THE senate of the University of Toronto has conferred the degree of LL.D., on Dr. S. Weir Mitchell, of Philadelphia.

AT the recent commencement of the Jefferson Medical College, of Philadelphia, the honorary degree of doctor of laws was conferred upon George Sumner Huntington, M.D., ScD., professor of anatomy, College of Physicians and Surgeons, Columbia University. Professor Huntington delivered an address on 'Modern advances in the teaching of anatomy and other medical sciences.'

PROFESSOR ROLLA C. CARPENTER, who holds the chair of experimental engineering at Cornell University, has been given the degree of doctor of laws by the University of Michigan.

NEW YORK UNIVERSITY has conferred the doctorate of laws on Dr. Joseph D. Bryant, of New York City, retiring president of the American Medical Association; on Charles W. Hunt, New York City, secretary of the American Society of Civil Engineers, and on Professor George F. Swain, professor of civil engineering of the Massachusetts Institute of Technology.

SIR WILLIAM RAMSAY, K.C.B., has received the Order of Commendatore della Corona d'Italia from the King of Italy.

The friends of Dr. K. Mitsukuri, the distinguished professor of zoology and dean of the School of Science of the Imperial University in Tokyo, have been pained to learn that he was attacked on April 17 with apoplexy. After lying unconscious for a week or more he was on May 13 slightly better, but still seriously ill.

Dr. Thomas S. Fiske, professor of mathematics at Columbia University, has been given sabbatical leave of absence for next year.

Mr. Andrew Watt has been elected meteorological secretary of the Scottish Meteorological Society in succession to the late Dr. Buchan.

Professor Maurice Henriot has been appointed director of the Experimental Laboratory of the Paris Mint.

The Transvaal government has appointed a commission, consisting of Dr. Kynaston (Geological Survey Department), Mr. T. N. Leslie (Vereeniging), Mr. J. P. Johnson (Johannesburg), and Professor R. B. Young (Transvaal University College), 'to report to the government on the Bushmen paintings and stone etchings existing in the Transvaal, and as to what steps should be taken to preserve them from decay and mutilation.'

A grant of £150 has been made from the Balfour fund, Cambridge University to W. E. Agar, of King's College, in furtherance of his proposed expedition to the Paraguayan Chaco.

Dr. Bergen Davis, instructor in physics at Columbia University, has been appointed to the Ernest Kempton Adams fellowship for next year.

The fellowship sustained by the alumnæ association of the Woman's College of Baltimore, to be awarded annually to a member of the association, has this year been awarded to Miss Mary J. Hogue, of the class of 1905. Miss Hogue has already held the foundation scholarship in biology at Bryn Mawr College and the graduate scholarship in the same institution. She will pursue the study of biology in German universities. The Woman's College of Baltimore maintains three tables at the United States Marine Biological Laboratory at Woods Holl, Massachusetts. The following students have been awarded scholarships entitling them to the use of tables during the coming session: Anita Shemwell Dowell, Grace Imogene Guy, M. Louise Frazee.

The Phi Beta Kappa address at Vassar was given on June 10 by Dr. Elmer Ellsworth Brown, U. S. Commissioner of Education.

Dr. W. W. Folwell, professor of political economy at the University of Minnesota and formerly president of the institution, will make the address at Hobart College, on June 18, on the occasion of the laying of the cornerstone of the William Smith Hall of Science.

The two-hundredth anniversary of the birth of Linnæus was celebrated on May 23 at the Western College for Women, Oxford, Ohio. An address was made by Dr. John M. Coulter, head professor of botany in the University of Chicago.

We learn from English journals that among those upon whom an honorary degree was conferred at the recent celebrations at the University of Upsala in commemoration of the bicentenary of Linnæus were Mr. William Carruthers, F.R.S., former president of the Linnean Society of London, and Mr. Francis Darwin, F.R.S., who represented Cambridge University.

Speaking at the forty-seventh annual dinner of King's College, London, on May 27, Dr. Headlam, the principal, referred to the loss which the college has sustained by the death of Dr. MacFadyean, and suggested that there should be a public recognition of one who died as a martyr in the cause of science, and for the sake of amelioration of disease and the benefit of the human race.

Sir Dietrich Brandis, F.R.S., the son of Dr. C. H. Brandis, professor of philosophy at Bonn University, and for many years inspector general of the forests of India, died on May 29, at the age of eighty-three years.

There will be on June 19 a civil service examination for the position of scientific as-

sistant with a salary of $750 in the Bureau of Fisheries.

THE eastern branch of the American Society of Zoologists will hold its next annual meeting during convocation week at the Sheffield Scientific School, New Haven.

FOREIGN journals report that the movement for the institution of an Italian Association for the Advancement of Science, proposed at Milan last year, has now taken form and development under capable organizers, including Professor Romiti, of Pisa. The first meeting will be held at Parma in September next, when it is hoped that the sister associations of Europe and America will send delegates. Italy has many associations for the advancement of special sciences, but, as Professor Romiti has put it, she has yet to form an association which shall 'represent the synthesis' of them all. Attempts were made in 1839 and 1875 to start such an association on the British and German models, but they have had no successor. It is hoped and believed that the attempt which has now been renewed will result in the establishment of a permanent institution.

DR. LAWRENCE F. FLICK, director of the Phipps Institute, Philadelphia, and chairman of the committee on the International Congress of Tuberculosis, which is to be held in Washington in the fall of 1908, announces that he has received $35,000 in subscriptions to a fund of $100,000 which he is raising to meet the necessary expenses. The subscribers include Messrs. Martin Maloney and William H. Henscri, of Philadelphia; Messrs. Henry Phipps, George Blumenthal and Henry C. Frick, of New York, and Mr. Henry L. Higginson, of Boston.

MR. WILLIAM URBAN, of Brooklyn, N. Y., has recently presented his collection of minerals to Colgate University as a memorial to his friend, the late Rev. Edward Lathrop, D.D., who had been for some years before his decease president of the corporation of the university. The value of the collection is about $2,500, and it will be installed in the new Science Hall, which bears the name of Dr. Lathrop.

THE library of Mr. Stuart M. Samuel, M.P., which Messrs. Sotheby will sell on July 1, contains the author's autograph manuscript of Gilbert White's 'Natural History and Antiquities of Selborne,' in the form of letters to Thomas Pennant and Daines Barrington, and arranged in a folio volume. The MS. remained in the possession of the author's descendants until 1895, when it was sold at Sotheby's and acquired by the present owner.

THE Norddeutscher Lloyd and the Hamburg-Amerika Lines have agreed to allow to members proceeding to the Fourteenth International Congress of Hygiene and Demography, to be held at Berlin, September 23 to 29, a reduction on the price of tickets.

AN exceptional opportunity for the study of evaporation in relation to climate is afforded by the Salton Sea. As our readers are aware, the sea was created by the accidental turning of the Colorado River into the Salton Basin, a dry valley in southeastern California lying below the level of the ocean; and now that the river has been restored to its original channel the sea has begun to dry away. The time required for its complete dissipation is estimated at from ten to fifteen years, and during that period the accession of water from all sources will be nominal. It will thus constitute an evaporation pan on a grand scale, and the measurement of its progressive lowering will give valuable information to engineers charged with the planning of reservoirs. The matter is also of importance to meteorologists, and arrangements have been made for a joint investigation by the U. S. Weather Bureau, the U. S. Reclamation Service and the U. S. Geological Survey. To determine the relation of the evaporation to temperature, atmospheric humidity and wind, a group of meteorological stations are to be maintained in the Salton Basin; and the endeavor will be made to develop a general formula for the estimation of evaporation in any locality where the ordinary climatic factors are known. A reconnaissance of the region has just been made by a board composed of F. H. Bigelow, C. E. Grunsky and G. K. Gilbert, representing severally the bureaus mentioned above.

Beginning on June 2, the Boston Society of Natural History proposes to open its museum free to the public on Sunday afternoons from 1 to 5, during June, July, August and September of this year. The exhibition rooms are regularly open free on Wednesday and Saturday from 10 till 5, but it is believed that the Sunday afternoon opening will accommodate many who are unable to visit the museum on week days. For the last five years, under the direction of its curator, Mr. Charles W. Johnson, the society has expended its efforts in endeavoring to make the New England collections the chief display of the museum so that at the present time a very good representation of the New England fauna is on exhibition. It is the society's intention to build up the New England collection of animals and plants so that it shall be as nearly complete as possible. In addition to the specimens on exhibition, there is also a rapidly growing study collection of birds, shells, insects and plants which may be consulted upon application to the curator on week days. Since this is the only natural history museum in the city and the only one whose particular scope is limited to the preservation and study of the New England fauna and flora, it is hoped that this action on the part of the society in opening its museum to visitors on Sundays will arouse additional interest in the study of New England natural history and that the museum may be a center to which all who are interested in this study shall feel themselves welcome.

The New York Medical Record states that the Carnegie Institution of Washington, which has been bearing most of the cost of publication of the present series of the *Index Medicus,* announces that as the journal has not met with the support from the profession that was hoped for, unless it appears that the *Index Medicus* is of greater service to the medical profession and can help to support itself to a greater extent than in the past, it may become advisable to discontinue its publication. The *Index Medicus* was established in 1879, under the editorship of Dr. John S. Billings and Dr. Robert Fletcher, and was discontinued in 1899. The present series began with the number for January, 1903.

UNIVERSITY AND EDUCATIONAL NEWS

Announcement is made that the sum of $430,000 has been contributed to Columbia University towards erecting Kent Hall, a building for the school of law and the faculty of political science.

The Jefferson Medical College, Philadelphia, graduated, at its eighty-second annual commencement held on June 3, 126 students, of which 105 had received hospital appointments in the recent competitive examinations.

The University of Giessen will celebrate its three-hundredth anniversary from July 31 to August 4.

Professor A. J. Hopkins, A.B., Amherst, '85, Ph.D., Hopkins, '93, associate professor of chemistry at Amherst College, has been appointed head of the department in view of the retirement of Professor Elijah P. Harris.

At Dartmouth College promotions from instructor to assistant professor have been made as follows: Charles A. Proctor, mathematics; Julius A. Brown, physics; Dr. Charles E. Bolser, chemistry.

At Clark College, Dr. J. B. Porter has been promoted to an assistant professorship in psychology, and Dr. F. B. Williams, of Union College, has been called to an assistant professorship of mathematics.

Mr. H. F. Rolker, of the Johns Hopkins University, has been appointed private research assistant to Dr. J. Bishop Tingle, recently appointed to the chair of chemistry at the McMaster University, Toronto.

Dr. Alexander Hill has announced his intention of resigning from the mastership of Downing College, Cambridge.

Mr. H. Bateman, fellow of Trinity College, Cambridge, has been elected to the readership in mathematical physics, endowed by Professor Arthur Schuster to encourage research in mathematical physics.